

# National Advisory Committee for Aeronautics

## Research Abstracts

NO. 60

MARCH 30, 1954

### CURRENT NACA REPORTS

NACA Rept. 1114

A THERMODYNAMIC STUDY OF THE TURBINE-PROPELLER ENGINE. Benjamin Pinkel and Irving M. Karp. 1953. ii, 36p. diags. (NACA Rept. 1114. Formerly TN 2653)

Equations and charts are presented for computing performance parameters of a turbine-propeller engine for any given set of operating conditions and component efficiencies. In order to illustrate some of the turbine-propeller system performance characteristics, the total thrust horsepower per unit mass rate of air flow and the specific fuel consumption are presented for a wide range of flight engine design operating conditions and given design component efficiencies. The performance of a turbine-propeller engine containing a matched set of components is presented for a range of engine operating conditions. The influence of the characteristics of the individual components of off-design-point performance is shown. The flexibility of operation of two turbine-propeller engines is discussed; one engine has a divided turbine system in which the first turbine drives only the compressor and the second turbine independently drives the propeller, and the other engine has a connected turbine system which drives both the compressor and the propeller.

NACA Rept. 1115

DESIGN OF TWO-DIMENSIONAL CHANNELS WITH PRESCRIBED VELOCITY DISTRIBUTIONS ALONG THE CHANNEL WALLS. John D. Stanitz. 1953. ii, 40p. diags., 8 tabs. (NACA Rept. 1115. Formerly TN 2593; TN 2595)

A general method of design is developed for two-dimensional unbranched channels with prescribed velocities as a function of arc length along the channel walls. The method is developed for both compressible and incompressible, irrotational, nonviscous flow and applies to the design of elbows, diffusers, nozzles, and so forth. Two types of compressible flow are considered: the general type, with the ratio of specific heats equal to 1.4, for example, and the linearized type, in which the ratio of specific heats is -1.0. Two methods of solution are used. In part I, solutions are obtained by relaxation methods and in part II, solutions are obtained by a Green's function.

NACA Rept. 1116

APPLICATION OF A CHANNEL DESIGN METHOD TO HIGH-SOLIDITY CASCADES AND TESTS OF AN IMPULSE CASCADE WITH 90° OF TURNING. John D. Stanitz and Leonard J. Sheldrake. 1953. ii, 20p. diags., photos., 2 tabs. (NACA Rept. 1116. Formerly TN 2652)

A technique is developed for the application of a channel design method to the design of high-solidity cascades with prescribed velocity distributions as a function of arc length along the blade-element profile. The technique applies to both incompressible and subsonic linearized compressible (ratio of specific heats equal to -1.0), nonviscous, irrotational, fluid motion. An impulse cascade with 90° turning was designed for incompressible flow and was tested at the design angle of attack over a range of downstream Mach number from 0.2 to choke flow. To achieve good efficiency, the cascade was designed for prescribed velocities with maximum allowable blade loading according to limitations imposed by considerations of boundary-layer separation.

NACA Rept. 1124

DISPLACEMENT EFFECT OF A THREE-DIMENSIONAL BOUNDARY LAYER. Franklin K. Moore. 1953. ii, 5p. diags. (NACA Rept. 1124. Formerly TN 2722)

A method is described for determining the "displacement surface" of a known three-dimensional compressible boundary-layer flow in terms of the mass-flow defects associated with the profiles of the two velocity components parallel to the surface. The result is a generalization of the plane flow concept of displacement thickness introduced in order to describe how a thin boundary layer distorts the outer nonviscous flow. Numerical values are found for the known three-dimensional boundary-layer flow about a cone at a small angle of attack to a supersonic stream.

NACA Rept. 1127

ONE-DIMENSIONAL ANALYSIS OF CHOKED-FLOW TURBINES. Robert E. English and Richard H. Cavicchi. 1953. ii, 18p. diags. (NACA Rept. 1127. Formerly TN 2810)

\* AVAILABLE ON LOAN ONLY.

ADDRESS REQUESTS FOR DOCUMENTS TO NACA, 1724 F ST., NW., WASHINGTON 25, D. C., CITING CODE NUMBER ABOVE EACH TITLE; THE REPORT TITLE AND AUTHOR.

629.13082

U58v

It is indicated that the area ratios and equivalent blade speed are the controlling factors in the design and operation of high work output turbines. For the usual class of turbine, increasing the equivalent blade speed of a given stage makes the internal flow conditions less critical. Flow conditions within choked-flow turbines are not usually sensitive to manufacturing errors in area ratio even near the stator choking limit. Six criteria are stated that will aid in establishing from test data of multistage turbines which blade rows are choked and which are not. The variation in internal flow conditions with operating conditions for a turbine equipped with an adjustable stator is determined for one application of stator adjustment.

NACA Rept. 1130

**SOME EFFECTS OF FREQUENCY ON THE CONTRIBUTION OF A VERTICAL TAIL TO THE FREE AERODYNAMIC DAMPING OF A MODEL OSCILLATING IN YAW.** John D. Bird, Lewis R. Fisher and Sadie M. Hubbard. 1953. ii, 17p. diagrs., photo. (NACA Rept. 1130. Formerly TN 2657)

The directional damping and stability of a fuselage-vertical-tail model oscillating freely in yaw were measured at a Mach number of 0.14 and compared with the damping and stability obtained by consideration of the effects of unsteady lift. The effects of vertical-tail aspect ratio and compressibility as predicted by the theoretical treatments are discussed in relation to the experimental stability characteristics obtained by the free-oscillation and by the curved-flow procedures.

NACA TN 3073

**EXPERIMENTAL STRESS ANALYSIS OF STIFFENED CYLINDERS WITH CUTOUTS. PURE BENDING.** Floyd R. Schlechte and Richard Rosecrans. March 1954. 41p. diagrs., photo., 7 tabs. (NACA TN 3073)

Bending tests were made on a cylindrical semi-monocoque shell of circular cross section. The cylinder was tested without a cutout and then with a rectangular cutout which was successively enlarged through six sizes varying from  $30^\circ$  to  $130^\circ$  in circumference and from 1 to 2 bays in length. Strain measurements were made with resistance-type wire strain gages near the cutout on the stringers, the skin, and the rings for each size of cutout, and the stresses obtained are presented in tables.

NACA TN 3074

**A PRELIMINARY INVESTIGATION OF THE EFFECTS OF GUSTY AIR ON HELICOPTER-BLADE BENDING MOMENTS.** Joseph W. Jewel, Jr. and Paul J. Carpenter. March 1954. 28p. diagrs., photos. (NACA TN 3074)

A preliminary investigation has been made at the Langley helicopter test tower to determine the bend-

ing moments excited on typical helicopter rotor blades in quiet and gusty air. The results obtained from this investigation indicate that the effects of gusts on rotor-blade bending moments appear to be secondary compared with the vibratory moments attributed to the unsymmetrical rotor downwash for the 26-mph condition tested and analyzed. It was also found that the addition of weights at the blade tips reduced the magnitude of the blade vibratory bending moments.

NACA TN 3075

**MEASUREMENTS OF PRESSURE AND TEMPERATURE FOR APPRAISAL OF THE TEMPERATURE METHOD OF AIRSPEED CALIBRATION IN THE LOWER STRATOSPHERE.** Lindsay J. Lina. March 1954. 12p. diagrs., photo. (NACA TN 3075)

An investigation was made to determine whether the temperature and pressure conditions in the lower stratosphere would meet the requirements of the temperature method for accurate calibration of air-speed installations. Measurements of temperature and pressure were made in flights of a swept-wing fighter airplane on four clear days in March and April 1953 over land near Langley Field, Virginia. The results indicated that, although the temperature lapse rate was favorable to the method, large and erratic variations of temperature with time and distance precluded accurate calibration. Unfavorable atmospheric conditions had also been found previously in an investigation of the upper troposphere (NACA TN 2807).

NACA TN 3096

**THEORETICAL PREDICTION OF PRESSURE DISTRIBUTIONS ON NONLIFTING AIRFOILS AT HIGH SUBSONIC SPEEDS.** John R. Spreiter and Alberta Alksne. March 1954. (ii), 84p. diagrs. (NACA TN 3096)

Theoretical pressure distributions on nonlifting circular-arc airfoils in flows with high subsonic free-stream velocity are found by determining approximate solutions of an integral equation for transonic flow proposed by Oswatitsch. Solutions are obtained using an iteration process which differs from the classical methods in that the quadratic nature of the integral equation is recognized. Except for phenomena which are predominantly influenced by viscous effects, the results are in good accord with experimental data.

NACA TN 3097

**TURBULENT BOUNDARY-LAYER AND SKIN-FRICTION MEASUREMENTS IN AXIAL FLOW ALONG CYLINDERS AT MACH NUMBERS BETWEEN 0.5 AND 3.6.** Dean R. Chapman and Robert H. Kester. March 1954. 53p. diagrs., photos., 5 tabs. (NACA TN 3097)

Direct-force measurements have been made of the average skin-friction coefficient for completely turbulent flow along the cylindrical portion of heat-insulated cone-cylinder bodies of revolution having overall fineness ratios of 10, 15, and 25. Numerous boundary-layer surveys were made. Reynolds numbers between 4 million and 32 million were investigated. At a Mach number of 2.0, data were obtained for different pressure distributions by distorting the flexible-plate walls of the wind tunnel. The results show no significant effect of small pressure gradients and only a small effect of cylinder fineness ratio on the average skin-friction coefficient. For each fineness ratio the effect of Mach number is large and essentially the same for all Reynolds numbers investigated. Determinations of friction by the momentum method differed considerably from the more reliable direct-force measurements.

#### NACA TN 3099

IMPINGEMENT OF WATER DROPLETS ON AN ELLIPSOID WITH FINENESS RATIO 5 IN AXISYMMETRIC FLOW. Robert G. Dorsch, Rinaldo J. Brun and John L. Gregg. March 1954. 50p. diagrs., tab. (NACA TN 3099)

The presence of radomes and instruments that are sensitive to water films or ice formations in the nose section of all-weather aircraft and missiles necessitates a knowledge of the droplet impingement characteristics of bodies of revolution. Because it is possible to approximate many of these bodies with an ellipsoid of revolution, droplet trajectories about an ellipsoid of revolution with a fineness ratio of 5 were computed for incompressible axisymmetric air flow. From the computed droplet trajectories, the following impingement characteristics of the ellipsoid surface were obtained and are presented in terms of dimensionless parameters: (1) total rate of water impingement, (2) extent of droplet impingement zone, (3) distribution of impinging water, and (4) local rate of water impingement.

#### NACA TN 3100

STATISTICAL STUDY OF TRANSITION-POINT FLUCTUATIONS IN SUPERSONIC FLOW. J. C. Evvard, M. Tucker and W. C. Burgess, Jr. Appendix B. MATHEMATICAL PROCEDURES. Hugo Heermann. March 1954. 32p. diagrs., photos., tab. (NACA TN 3100)

The random movement of the transition point on a  $10^\circ$  cone at a free-stream Mach number of 3.12 was investigated by means of a large number of high-speed schlieren photographs. The distribution functions which statistically define the transition-point location were determined for a range of test-section Reynolds number and two levels of free-stream turbulence intensity. The intensity was varied by changing tunnel settling-chamber configurations. Temperature-recovery-factor distributions were also obtained. The axial extent of the distribution function determined from the schlieren data increased with turbulence level. The axial spread of the transition region denoted by the recovery-factor measurements roughly corresponded to that of the appropriate distribution function. These data suggest that a

relatively sharp transition from laminar to turbulent flow takes place and that this flow pattern moves randomly along the aerodynamic surface. With the use of the statistical distribution functions obtained from the data and surface temperatures (as time-averaged by the surface thermocouples), the instantaneous surface-temperature distributions were calculated for two Reynolds numbers.

#### NACA TN 3102

AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE TRANSIENT RESPONSE OF A PRESSURE-REGULATING RELIEF VALVE IN A HYDRAULIC CIRCUIT. Harold Gold and Edward W. Otto. March 1954. 54p. diagrs., photo., 3 tabs. (NACA TN 3102)

The transient response of the pressure-regulating relief valve in a hydraulic circuit is analyzed by means of an electrical analogy of the hydraulic circuit. Measurements of the transient response of a hydraulic relief valve are presented and are compared with responses calculated from the differential equation of the equivalent electric network. The comparison of experimental and analytical responses shows that the response of the relief valve can be adequately predicted by means of the equivalent network. The analysis of a typical relief valve by means of the equivalent network indicates that viscous damping is negligible and that the principle damping is derived from the flow resistance of the various elements of the hydraulic circuit. An expression is analytically developed that yields directly the area-lift relation for the relief valve for stable valve operation over the wide flow-rate ranges.

#### NACA TN 3103

COOLING REQUIREMENTS FOR STABILITY OF LAMINAR BOUNDARY LAYER WITH SMALL PRESSURE GRADIENT AT SUPERSONIC SPEEDS. George M. Low. March 1954. 16p. diagrs., tab. (NACA TN 3103)

The amount of cooling required to stabilize the two-dimensional supersonic laminar boundary layer for all Reynolds numbers is calculated for flows with pressure gradients of a magnitude usually encountered over slender aerodynamic shapes. Only two-dimensional disturbances are treated in the stability calculations. It is determined that small pressure gradients have an appreciable effect on stability. The cooling due to radiation alone may suffice, at moderate supersonic Mach numbers, to completely stabilize the boundary layer over wings with favorable pressure gradients. For flows with adverse pressure gradients, the cooling required for complete stability is considerably greater than that for flat-plate flows.

#### NACA TN 3104

EXPERIMENTAL INVESTIGATION OF SUBLIMATION OF ICE AT SUBSONIC AND SUPERSONIC SPEEDS AND ITS RELATION TO HEAT TRANSFER. Willard D. Coles and Robert S. Ruggeri. March 1954. 29p. diagrs., photo. (NACA TN 3104)

An experimental investigation was conducted in the 3.84- by 10-inch tunnel to determine the mass transfer by sublimation, heat transfer, and skin friction for an iced surface at subsonic and supersonic speeds. The results show that the Stanton numbers of sublimation and heat transfer were increased 40 to 50 percent for an iced surface of moderate roughness as compared with those obtained for a bare plate. For ice surfaces of equivalent roughness, the ratio of sublimation to heat-transfer Stanton numbers was found to be 0.90. Sublimation Stanton numbers obtained at a Mach number of 1.3 showed no appreciable deviation from those obtained at subsonic speeds. Sublimation as a means of removing ice formations of appreciable thickness is so slow as to be of little value in the de-icing of aircraft at high altitudes.

## NACA TN 3105

**AERODYNAMICS OF SLENDER WINGS AND WING-BODY COMBINATIONS HAVING SWEEPED TRAILING EDGES.** Harold Mirels. March 1954. ii, 96p. diagsr. (NACA TN 3105)

A general method, based on two-dimensional cross-flow concepts, is presented for obtaining the lift and moments on highly swept wings. Emphasis is placed on obtaining solutions for wings having swept trailing edges. The method is applicable for all problems where the velocity boundary conditions can be made homogeneous by differentiation in the streamwise or spanwise directions. Lift, roll, and pitch solutions, for highly swept wings, are presented. Both direct problems and inverse problems are considered. Applications of the method for the solution of wing-body problems and unsteady two-dimensional incompressible flow problems are also indicated.

## NACA TN 3107

**EFFECT OF HEAT TREATMENT UPON THE MICROSTRUCTURE AND HARDNESS OF A WROUGHT COBALT-BASE ALLOY STELLITE 21** (AMS 5385). F. J. Clauss and J. W. Weeton. March 1954. 26p. diagsr., photos. (NACA TN 3107)

An investigation has been made to study the response of wrought Stellite 21 to heat treatment. A period of 72 hours at 2250° F was sufficient for effective solution treatment of this alloy. Pearlitic structures formed at grain boundaries of solution-treated specimens during isothermal transformation at 1950°, 1750°, and 1500° F. A Widmanstaetten structure also formed during transformation at 1750° and 1500° F. Little visible precipitate formed by transformation at 1200° F for times up to 72 hours. Water quenching from 2250° F followed by aging at temperatures from 1200° to 1950° F resulted in precipitation principally along slip lines and twin boundaries. Spheroidization and agglomeration of precipitates occurred at temperatures as low as 1500° F. Isothermal or aging treatments above 1200° F increased the hardness of the solution-treated specimens. A maximum hardness of Rockwell C-42 was developed by aging 72 hours in the temperature range from 1400° to 1500° F, as

compared to Rockwell C-20 to C-22 for the solution-treated condition. Overaging or softening occurred within 72 hours at temperatures of 1750° F and above for aging, and 1950° F for isothermal transformation.

## NACA TN 3108

**RELATION OF MICROSTRUCTURE TO HIGH-TEMPERATURE PROPERTIES OF A WROUGHT COBALT-BASE ALLOY STELLITE 21** (AMS 5385). F. J. Clauss and J. W. Weeton. March 1954. 49p. diagsr., photos., tab. (NACA TN 3108)

An investigation was conducted to determine the effects of microstructure on stress-rupture life of heat-treated wrought Stellite 21. Wrought Stellite 21, which may be considered a typical cobalt-base precipitation-hardening alloy, was found to respond readily to solution treatment and to isothermal and aging heat treatments to form pearlitic and Widmanstaetten structures as well as scattered precipitates. The results obtained in this investigation, although determined specifically for the alloy wrought Stellite 21, lead to conclusions that are believed to have general significance in the heat treatment of other high-temperature alloys. The optimum high-temperature properties are associated with a dispersion of fine precipitate scattered throughout the grains of the microstructure. Such scattered precipitation was produced by solution treatment followed by a low-temperature aging treatment to develop nucleation sites and higher-temperature age to develop visible precipitation in the scattered nucleation sites.

## NACA TN 3109

**AN INVESTIGATION OF LAMELLAR STRUCTURES AND MINOR PHASES IN ELEVEN COBALT-BASE ALLOYS BEFORE AND AFTER HEAT TREATMENT.** J. W. Weeton and R. A. Signorelli. March 1954. 50p. diagsr., photos., 12 tabs. (NACA TN 3109)

An investigation of the occurrence and nature of lamellar structures and minor phases of eleven cobalt-base high-temperature alloys (rolled, cast, and high-carbon Stellite 21, 422-19, X-63, 6059, 61, X-40, S-816, I-336, and J). The minor phases TaC, NbC, Cr<sub>3</sub>C<sub>2</sub>, Cr<sub>7</sub>C<sub>3</sub>, Cr<sub>23</sub>C<sub>6</sub>, M<sub>6</sub>C, Cr<sub>2</sub>O<sub>3</sub> type oxides, spinels, and sigma were identified by X-ray diffraction analysis. Sigma phase patterns appeared strongest where large numbers of carbides were also present, indicating that carbide precipitation may facilitate sigma phase formation. The most prevalent carbide indicated was Cr<sub>23</sub>C<sub>6</sub>. One of the two phases of the pearlitic structure consisted predominantly of the carbide Cr<sub>23</sub>C<sub>6</sub>.

## NACA TN 3111

**FRICTION AND WEAR INVESTIGATION OF MOLYBDENUM DISULFIDE. II - EFFECTS OF CONTAMINANTS AND METHOD OF APPLICATION.** Marshall B. Peterson and Robert L. Johnson. March 1954. 19p. diagsr., photos., tab. (NACA TN 3111)

An experimental study was conducted using a low-speed kinetic-friction apparatus to show the effects of method of application and contaminants on the lubricating characteristics of molybdenum disulfide  $\text{MoS}_2$ . Friction coefficients for a purified grade of  $\text{MoS}_2$  can vary from 0.025 to 0.12 merely by changing the method of application. Contaminants present in commercial grades of  $\text{MoS}_2$  do not increase friction but can (for example, 0.5 percent silica) adversely affect wear. In room atmosphere, small amounts of oil (5 to 10 percent) reduce friction below that obtained with either purified  $\text{MoS}_2$  or with oil alone. At least 10 percent  $\text{MoS}_2$  should be present in the oil to obtain the lowest friction. The lowest friction values were obtained at the highest temperatures used ( $300^\circ\text{F}$ ) where the adverse effects of moisture were minimized.

#### NACA TN 3112

ANALOG STUDY OF INTERACTING AND NON-INTERACTING MULTIPLE-LOOP CONTROL SYSTEMS FOR TURBOJET ENGINES. George J. Pack and W. E. Phillips, Jr. March 1954. 33p. diagrs., photos. (NACA TN 3112)

An analog investigation of several turbojet control configurations was made. Both proportional and proportional-plus-integral controllers were studied, and compensating terms for engine interaction were added to the control system. Data were taken on the stability limits and the transient responses of these various configurations. Analytical expressions in terms of the component transfer functions were developed for the configurations studied and the optimum form for the compensation terms was determined. It was found that the addition of the integral term, while making the system slower and more oscillatory, was desirable in that it made the final values of the system parameters independent of source of disturbance and also eliminated droop in these parameters. Definite improvement in system characteristics results from the use of proper compensation terms. At comparable gain points the compensated system is faster and more stable. Complete compensation eliminates engine interaction permitting each loop to be developed to an optimum point independently.

#### NACA TN 3126

A DESIGN STUDY OF LEADING-EDGE INLETS FOR UNSWEPT WINGS. Robert E. Dannenberg. March 1954. 56p. diagrs., photos., 3 tabs. (NACA TN 3126. Formerly RM A9K02b)

A method is presented for calculating the profile coordinates for an inlet to be placed in the leading edge of an airfoil from formulas. The method includes an application of the principles of thin-airfoil theory which permits the change in velocity distribution caused by a variation in inlet profile to be calculated. Wind-tunnel tests of leading-edge inlets in an airfoil having the NACA 631-012 section were made to evaluate the effects of the inlets on the aerodynamic characteristics of the airfoil. The results indicated

that the airfoil with an inlet devised by the design method had satisfactory aerodynamic characteristics.

#### NACA TN 3127

THE EFFECTIVENESS AT HIGH SUBSONIC MACH NUMBERS OF A 20-PERCENT-CHORD PLAIN TRAILING-EDGE FLAP ON THE NACA 65-210 AIRFOIL SECTION. Louis S. Stivers, Jr. March 1954. 15p. diagrs. (NACA TN 3127)

The lift-control characteristics of a 20-percent-chord plain trailing-edge flap on the NACA 65-210 airfoil section have been analyzed for Mach numbers from 0.30 to 0.875 utilizing section lift-coefficient data. In addition, the relative merits of the plain flap, a spoiler, and a dive-recovery flap employed separately as a lift-control device on the NACA 65-210 airfoil section have been determined from increments of section lift, drag, and pitching-moment coefficients which accompanied the deflection of each control device. The Reynolds number of the data varied with Mach number from about  $1 \times 10^6$  to  $2 \times 10^6$ .

#### NACA TN 3129

INVESTIGATION OF A SLAT IN SEVERAL DIFFERENT POSITIONS ON AN NACA 64A010 AIRFOIL FOR A WIDE RANGE OF SUBSONIC MACH NUMBERS. John A. Axelson and George L. Stevens. March 1954. 35p. diagrs., photos., 7 tabs. (NACA TN 3129)

An investigation of a slat in several different positions on an NACA 64A010 airfoil has been conducted over a Mach number range from 0.25 to 0.85, corresponding to a Reynolds number range from 3.4 million to 8.1 million. Section force coefficients and chordwise distributions of pressure and resultant loading are presented for several different locations of the slat. The loading on the slat rather than the effects of the air flowing through the gap was found to be the primary factor determining slat performance.

#### NACA TN 3143

EXPERIMENTAL DETERMINATION OF THERMAL CONDUCTIVITY OF LOW-DENSITY ICE. Willard D. Coles. March 1954. 12p. diagrs., photo. (NACA TN 3143)

The thermal conductivity of low-density ice has been computed from data obtained in an experimental investigation of the heat transfer and mass transfer by sublimation for an iced surface on a flat plate in a high-velocity tangential airstream. The results are compared with data from several sources on the thermal conductivity of packed snow and solid glaze ice. The results show good agreement with the packed-snow values, and the extension of the curves for packed snow to the solid ice regime indicates that the curves are applicable to ice over the entire density range.

## NACA TN 3162

EFFECTS OF SUBSONIC MACH NUMBER ON THE FORCES AND PRESSURE DISTRIBUTIONS ON FOUR NACA 64A-SERIES AIRFOIL SECTIONS AT ANGLES OF ATTACK AS HIGH AS  $28^\circ$ . Louis S. Stivers, Jr. March 1954. 145p. diagrs., photos., 8 tabs. (NACA TN 3162)

A high-speed wind-tunnel investigation has been made of the NACA 64A010, 64A410, 64A006, and 64A406 airfoil sections at angles of attack as high as  $28^\circ$ . Pressure-distribution, lift, drag, and moment characteristics were determined for each airfoil section at Mach numbers ranging from 0.30 to about 0.93, with corresponding Reynolds numbers varying from approximately  $0.9 \times 10^6$  to  $1.9 \times 10^6$ . The  $a = 0.8$  (modified) mean line was employed for the cambered airfoil sections.

## NACA TN 3164

FURTHER STUDIES OF THE MECHANISM BY WHICH HYDROGEN ENTERS METALS DURING CHEMICAL AND ELECTROCHEMICAL PROCESSING. L. D. McGraw, W. E. Ditmars, C. A. Snively and C. L. Faust, Battelle Memorial Institute. March 1954. 37p. diagrs., 4 tabs. (NACA TN 3164)

This investigation was a continuation of efforts to develop fundamental concepts which would be useful in preventing or alleviating hydrogen damage to steel. NACA Technical Note 2696 presented a new mechanism which postulates that the entry of hydrogen into metals from chemical and electrochemical action occurs when hydrogen-metal alloy formation is simultaneous with discharge (or release) of hydrogen atoms. In the present work the phenomena relating to hydrogen entry into steel were studied further. In general, the results support the newly postulated concepts.

## NACA TN 3167

THERMAL CONDUCTANCE OF CONTACTS IN AIRCRAFT JOINTS. Martin E. Barzelay, Kin Nee Tong and George Hollo, Syracuse University. March 1954. 47p. diagrs., photos., 2 tabs. (NACA TN 3167)

Tests were conducted to determine the factors influencing the thermal conductance across the interface between 75S-T6 aluminum-alloy and AISI Type 416 stainless-steel structural joints. From the results it was concluded that (1) the thermal conductance of the interface joint increases with mean temperature level, while it remains approximately constant with changes in heat flow; (2) thin foils of good conducting materials inserted between the interfaces improve the heat transfer noticeably; (3) common strength-giving bonding materials produce joints with very poor thermal conductivity; and (4) none of the three modes of heat transfer (metal-to-metal conduction, air-film conduction, and radiation) has any predominance over another across the interface joints and, furthermore, there is an interdependence among these three which has not previously been recognized.

## NACA TN 3177

ION TRACER TECHNIQUE FOR AIRSPEED MEASUREMENT AT LOW DENSITIES. W. B. Kunkel and L. Talbot, University of California. March 1954. 31p. diagrs. (NACA TN 3177)

A study has been made of the aerodynamic and production detection problems associated with ion tracer velocity measurement techniques, with particular emphasis on those aspects unique to low-density gas dynamics. A critical survey was made of the various techniques which have been employed and specific suggestions are offered relative to the successful use of ion tracer velocity measuring methods at low densities. A description is also included of some experimental work carried out with an ion-pulse airspeed indicator developed by the Ames Aeronautical Laboratory Low Pressures Group of the National Advisory Committee for Aeronautics for use in low-density wind tunnels.

## NACA TN 3190

FATIGUE INVESTIGATION OF FULL-SCALE TRANSPORT-AIRPLANE WINGS. SUMMARY OF CONSTANT-AMPLITUDE TESTS THROUGH 1953. M. J. McGuigan, Jr., D. F. Bryan and R. E. Whaley. Appendix A. NOTES ON THE USE OF BONDED WIRES TO DETECT FATIGUE CRACKS. M. H. Levin. March 1954. 45p. diagrs., photos., 3 tabs. (NACA TN 3190)

Results are presented of constant-amplitude fatigue tests on the wings of C-46 airplanes. Eight complete wings were tested at four alternating load levels ranging from  $7\frac{1}{2}$  to 22 percent of the design ultimate load factor. All tests were conducted with a 1g mean load, which is about 22 percent of the design ultimate load factor. All failures which occurred are classified in five types according to the structural stress raisers in which they originated. Effective stress-concentration factors were determined for each stress raiser where failures occurred, the rate and manner of fatigue-crack propagation was investigated, and the effect of the magnitude of load on these items was determined. The scatter in fatigue life of the wings was analyzed statistically. The load-lifetime relationship of the test structure was compared with that of several other full-scale and component structures which have been subjected to fatigue tests. An appendix by M. H. Levin presents information on the use of bonded wires to detect small fatigue cracks; another appendix deals with the use of fiber glass as a method of structural repair.

## NACA RM 53L22

ADDITIONAL FATIGUE TESTS ON EFFECTS OF DESIGN DETAILS IN 355-T6 SAND-CAST ALUMINUM ALLOY. I. D. Eaton and John A. Youra, Aluminum Company of America. March 1954. 24p. diagrs., photos., 5 tabs. (NACA RM 53L22)

Additional static and fatigue tests were made on aluminum-alloy 355-T6 sand-cast specimens. Direct stress fatigue tests were made on plate-type speci-

mens with a single 1-inch-diameter as-cast cored hole and on specimens in which the cored hole was reamed to 1-1/16 inch diameter. In addition, direct-stress fatigue tests were made on 0.300-inch-diameter specimens, with various degrees of porosity, machined from the butt ends of plate-type specimens. Comparisons are made with results of earlier tests, on plate-type specimens with variations in design details such as bosses and ribs, given in NACA Technical Note 2394.

#### NACA RM E53J30

**EFFECT OF ICE FORMATIONS ON SECTION DRAG OF SWEEP NACA 63A-009 AIRFOIL WITH PARTIAL-SPAN LEADING-EDGE SLAT FOR VARIOUS MODES OF THERMAL ICE PROTECTION.** Uwe H. von Glahn and Vernon H. Gray. March 1954. 59p. diags., photos. (NACA RM E53J30)

Studies were made to determine the effect of ice formations on the section drag of a 6.9-foot-chord 36° swept NACA 63A-009 airfoil with partial-span leading-edge slat. In general, the icing of a thin swept airfoil will result in greater aerodynamic penalties than for a thick unswept airfoil. Glaze-ice formations at the leading edge of the airfoil caused large increases in section drag even at a liquid-water content of 0.39 gram per cubic meter. The use of an ice-free parting strip in the stagnation region caused a negligible change in drag compared with a completely unheated airfoil. Cyclic de-icing when properly applied caused the drag to decrease almost to the bare-airfoil drag value.

#### NACA RM E53K24

**KINETIC STUDY OF MASS TRANSFER BY SODIUM HYDROXIDE IN NICKEL UNDER FREE-CONVECTION CONDITIONS.** Don R. Mosher and Robert A. Lad. March 1954. 14p. diags., photo., tab. (NACA RM E53K24)

An investigation was conducted using static capsules fabricated from "L" nickel tubing to determine the effect of temperature level, temperature gradient, and test duration on corrosion and mass transfer by molten sodium hydroxide under free-convection conditions. A base temperature range from 1000° to 1600° F with temperature differences to 500° was studied. The rate of mass transfer was found to be strongly dependent on both temperature level and gradient. The rate shows little tendency to decrease for test durations up to 200 hours, although the concentration of nickel in the melt approaches a limiting value after 100 hours.

#### NACA RM E53L21

**PRELIMINARY INVESTIGATION OF THE "FREEZE-CASTING" METHOD FOR FORMING REFRACTORY POWDERS.** W. A. Maxwell, R. S. Gurnick and A. C. Francisco. March 1954. 19p. diags., photos., 2 tabs. (NACA RM E53L21)

A method of preparing intricately shaped objects from refractory powders was investigated. The

method consists in preparing an extremely thick slip with a small amount of binder, casting the slip into a mold, and freezing to retain the shape of the casting. The casting is then dried by sublimation and may subsequently be sintered by conventional means. It was found possible to cast high-solid-content slips by employing vibration during the casting process. Turbosupercharger blades of good appearance and free from radiographic flaws were produced. The factors affecting the density of a casting before sintering were determined.

#### NACA RM E53L21b

**A FLOW CALORIMETER FOR DETERMINING COMBUSTION EFFICIENCY FROM RESIDUAL ENTHALPY OF EXHAUST GASES.** Albert Evans and Robert R. Hibbard. March 1954. 21p. diags., 2 tabs. (NACA RM E53L21b)

A flow calorimeter for determining the combustion efficiency of turbojet and ram-jet combustors from measurement of the residual enthalpy of combustion of the exhaust gas is described. Briefly, the calorimeter catalytically oxidizes the combustible constituents of exhaust-gas samples, and the resultant temperature rise is measured. This temperature rise is related to the residual enthalpy of combustion of the sample by previous calibration of the calorimeter. Combustion efficiency can be calculated from a knowledge of the residual enthalpy of the exhaust gas and the combustor input enthalpy. An accuracy of ±0.2 Btu per cubic foot was obtained with prepared fuel-air mixtures, and the combustion efficiencies of single turbojet combustors measured by both the flow-calorimeter and heat-balance methods compared within 3 percentage units. Flow calorimetry appears to be a suitable method for determining combustion efficiencies at high combustor temperatures where ordinary thermocouples cannot be used. The method is fundamentally more accurate than heat-balance methods at high combustion efficiencies and can be used to verify near-100-percent efficiency data.

## BRITISH REPORTS

N-28582\*

Forest Products Research Lab. (Gt. Brit.)  
**TRIALS OF TIMBERS FOR PLYWOOD MANUFACTURE.** AGBA - GOSSWEILERODENDRON BALSAMIFERUM-HARMS - NIGERIA. (32 POUNDS PER CUBIC FOOT AT 15 PER CENT MOISTURE CONTENT) PROGRESS REPORT TWENTY-THREE. October 1953. 14p. 6 tabs. (Forest Products Research Lab.)

Average quality logs of Agba were selected and tested to provide comparable data with those of Khaya and Sapele. Results of processing are given. Characteristics are presented of the veneer and finally the potentialities of Agba for plywood manufacture are given.

N-28777\*

Aeronautical Research Council (Gt. Brit.)  
THE LOSS IN CLIMB PERFORMANCE, RELATIVE  
TO THE OPTIMUM, ARISING FROM THE USE OF A  
PRACTICAL CLIMB TECHNIQUE. K. J. Lush.  
1953. 12p. diags., 2 tabs. (ARC R & M 2756;  
ARC 12,563. Formerly AAE/Res/243)

A practical climb technique will not in general comply with the condition for optimum climb performance and will give an inferior climb. An assessment of the loss of performance involved is, therefore, desirable. A practical climb technique is considered which is defined by a fixed relation between equivalent air speed (or Mach number) and pressure altitude, and a rough estimate made of the loss in performance involved in using such a technique with a turbine jet aircraft over a range of air temperature, engine speed, thrust, or aircraft weight. An approximate method of calculating a suitable relation is given in an appendix. If the technique for optimum climb is not fixed by compressibility effects, use of such a practical climb technique will result in a loss of performance, relative to the optimum, less than the greater of 1 percent and 1/2 ft/sec in rate of climb over a wide range of aircraft weight or a moderate range of air temperature, engine speed or thrust. Approximate limits are quoted in table 2. More precise limits may be estimated for any particular aircraft. If the technique for optimum climb is determined by compressibility effects such a practical climb technique can give optimum performance over a wide range of weight, air temperature, and engine speed.

N-28778\*

Aeronautical Research Council (Gt. Brit.)  
THE ELASTIC STABILITY OF SANDWICH PLATES.  
J. H. Hunter-Tod. 1953. 39p. diags. (ARC  
R & M 2778; ARC 12,550. Formerly College of  
Aeronautics, Cranfield, Rept. 25)

This paper treats the elastic stability of supported rectangular plates of sandwich construction with isotropic and anisotropic fillings under compression and shear loading. Formulas are developed for critical stresses for flat and curved panels in compression and flat panels in shear for the buckling of the whole panel, also for the wrinkling or local failure of the faces of flat panels in compression. It is established that for a wide range of conditions the critical stress for panels buckling in compression is independent of the form of the filling providing it is symmetrical about the normal; of the elastic constants of the filling only the transverse shear is of concern. As a result a simple extension of the equivalent plate theory of greatly improved accuracy is developed enabling the use of equations treating the plate as a whole.

N-28779\*

Aeronautical Research Council (Gt. Brit.)  
THE TURBULENT BOUNDARY LAYER IN COMPRESSIBLE FLOW. W. F. Cope. 1953. 8p. diags., tab. (ARC R & M 2840; ARC 7634 (rev.)). Formerly Nat. Physical Lab., Engineering Dept. rept.)

The flow of a compressible gas past a flat plate is investigated for a turbulent boundary layer. The local and mean skin-friction coefficients are calculated for both power and log laws of velocity distribution. The calculations show a considerable reduction of both coefficients with increasing  $M$ . In the course of the analysis, assumptions have been made whose accuracy is not proven, though they are consistent with those made in incompressible gas dynamics. The results are applied to calculate the contribution to  $f_r$  of skin friction for a typical projectile of various calibers. The calculation shows that it should be possible by a properly selected series of wind-tunnel and full-scale experiments to ascertain if the large reduction in skin friction occurs, but that it is unlikely that it will be possible to discriminate between the two hypotheses about velocity distribution.

N-28780\*

Aeronautical Research Council (Gt. Brit.)  
FOUR STUDIES IN THE THEORY OF STRESS CONCENTRATION. H. L. Cox. January 1950. ii, 58p. diags., 9 tabs. (ARC R & M 2704. Formerly Nat. Physical Lab., Engineering Div. Repts. 359/48; 361/48; 360/48; 362/48; 444A/50)

The four papers comprised in this monograph are a study of some of the theoretical aspects of experimental work in progress in the National Physics Laboratory from 1937 to 1947. The greater part of the work is related to failure of materials by fatigue and chief attention is paid to this mode of failure. Parts II and IV deal with the development of means to compute the stress distribution in the neighborhood of holes, grooves, and fillets. Part I is mainly concerned with the effect of holes and internal flaws. Part III deals with the effect of surface irregularities on fatigue strength.

N-28781\*

Aeronautical Research Council (Gt. Brit.)  
A THEORETICAL APPROACH TO THE DESIGN OF HYDROFOILS. C. H. E. Warren. 1953. 20p. diags., 5 tabs. (ARC R & M 2836; ARC 10,181. Formerly RAE Tech. Note Aero 1739; Tech. Note Aero 1826)

An investigation has been made into the application of the theory of thin sections to the design of hydrofoils having high cavitation speeds. Consideration is given to both symmetrical sections, which themselves are suitable for struts, and camber-lines, which, when used with the symmetrical sections, lead to cambered sections which are suitable for lifting surfaces. In all the aim has been to keep the peak local velocities to a minimum and the sections developed differ from "low-drag" airfoil sections mainly in that, being hydrofoils, the sections have sharp leading edges. The theoretical optimum section consists of an elliptic symmetrical section superimposed on a logarithmic camber-line. Typical practical sections will cavitate at a speed lower by about 5 knots than the theoretical optimum section of the same thickness/chord ratio and at the same lift coefficient. For strut sections, it is shown that sections having high cavitation speeds at zero incidence tend to be inferior to other sections at incidences as small as  $2^\circ$ . For lifting surface

sections it is shown that although a high cavitation speed demands a low design lift coefficient, a high loading at cavitation demands a high design lift coefficient. Operation above cavitation speeds or over wide ranges of lift coefficient is not considered.

N-28782\*

Aeronautical Research Council (Gt. Brit.)  
WIND-TUNNEL TESTS ON THE PREVENTION OF  
BOUNDARY-LAYER SEPARATION BY DISTRIBUTED  
SUCTION AT THE REAR OF A THICK AEROFOIL  
(NPL 153). N. Gregory, R. C. Pankhurst and W. S.  
Walker. 1953. 7p. diagrs., tab. (ARC R & M 2788.  
Formerly ARC 13,446; Perf. 702; FM 1485)

Tests of a preliminary nature have been carried out on a 33-percent-thick symmetrical airfoil (NPL 153) with suction through a porous-surface from 0.80 chord to the trailing edge, which was rounded and fitted with a Thwaites flap. The distributed suction was found to prevent separation and to reduce the wake drag to zero. The overall effective drag (including an allowance for the power required for the suction) was reduced slightly, but still remains fairly high. No hysteresis was observed in the change of drag with suction quantity. The flap was essential to stabilize the flow: without it, the flow with suction was unsteady and the wake drag was appreciable. When the flap was deflected  $20^\circ$ , there was no increase in the suction quantity required to prevent separation.

N-28783\*

Aeronautical Research Council (Gt. Brit.)  
NOTE ON AERODYNAMIC CAMBER. H. C. Garner.  
1953. 14p. (ARC R & M 2820. Formerly ARC  
13,092; S & C 2391; Perf. 656)

An explanation is given of the theoretical significance of camber derivatives. The various available methods of making experimental measurements with particular reference to the use of a curved-flow tunnel are discussed. There is particular need for systematic information about the influence of curvature of flow on control hinge-moments as a step towards the understanding of three-dimensional viscous flow.

N-28784\*

Aeronautical Research Council (Gt. Brit.)  
NOTE ON THE USE OF THE THREE-DIMENSIONAL  
SHOCK-WAVE RECORDER FOR STUDYING INTER-  
FERENCE IN A SUPERSONIC WIND TUNNEL. A. O.  
Ormerod. 1953. 9p. diagrs., photo. (ARC R & M  
2798; ARC 13,940. Formerly RAE Tech. Note Aero  
2088)

A description is given of the shock-wave recorder which has been used to investigate wind-tunnel interference on a sting-mounted wing having  $50^\circ$  of sweepback. Diagram of the shock-wave patterns round the wing is given for Mach numbers 1.4, 1.6, and 1.8 and angles of attack of  $0^\circ$  and  $4^\circ$ .

N-28785\*

Aeronautical Research Council (Gt. Brit.)  
NATURAL FREQUENCIES AND MODES OF A  
MODEL DELTA AIRCRAFT. D. R. Gaukroger.  
1953. 32p. diagrs., tab. (ARC R & M 2762; ARC  
13,377. Formerly RAE Structures 75)

Resonance tests on a model delta wing are described. Consideration is given to the effect of inertia distribution on the first three normal symmetric modes of vibration. The mean center-of-gravity position, fuselage pitching moment of inertia and wing inertia axis have been independently varied, and the effect of concentrated tip masses has been examined. Results are given which are intended as a general guide in flutter calculations.

N-28854\*

Royal Aircraft Establishment (Gt. Brit.)  
A SIMPLE METHOD OF PROVIDING AUTOMATIC  
ZERO ADJUSTMENT IN A POSITION-CONTROL  
SERVOMECHANISM EMPLOYING A D.C.  
AMPLIFIER. L. A. J. Lawrence. October 1953.  
17p. diagrs. (RAE Tech. Note GW 280)

A system is described for the removal of accumulated drift from the output of a position-control servomechanism employing a d-c amplifier. The factors governing the accuracy of the zero at the instant of adjustment and its subsequent accuracy are both discussed, together with practical results and circuit details.

N-28855\*

Royal Aircraft Establishment (Gt. Brit.)  
ON THE LAMINAR BOUNDARY LAYER SEPARA-  
TION FROM THE LEADING EDGE OF A THIN  
AEROFOIL. P. R. Owen and L. Klanfer. October  
1953. 19p. diagrs., 6 tabs. (RAE Aero 2508)

Low-speed wind tunnel tests have shown that when a laminar boundary layer separates from the leading edge of a thin airfoil at angle of attack, the flow often becomes attached to the surface again some distance downstream. It is suggested that the length of the "bubble" depends primarily on the Reynolds number based on the displacement thickness at the separation point. This Reynolds number in turn depends on the distance of the velocity peak on the upper surface of the airfoil from the stagnation point and it is inferred that, at a Reynolds number based on the chord, a long bubble is more likely to occur when the velocity peak is close to the stagnation point.

N-28856\*

Aeronautical Research Council (Gt. Brit.)  
TABULATION OF THE BLASIUS FUNCTION WITH  
BLOWING AND SUCTION. H. W. Emmons and D. C.  
Leigh. June 5, 1953. 81p. diagrs., 3 tabs. (ARC  
15,966; FM 1913)

The present solutions were obtained in connection with the solution of a combustion problem. The whole possible range of blowing and suction values is

covered in this paper. Calculations were done on the Electronic Delay Storage Automatic Calculator and the results are included in table form.

N-28858\*

Aeronautical Research Council (Gt. Brit.)  
LARGE SCALE ATMOSPHERIC FLOW PATTERNS  
IN THE LABORATORY. T. V. Davies. May 5, 1953.  
6p. diagr., photos. (ARC 15,876; FM 1896)

A brief description is given of laboratory apparatus which simulates the large scale features of atmospheric motion. Also given are principal results obtained together with the explanation of the correspondence between experimental flows and atmospheric flows. The research work has been conducted principally at the Department of Meteorology, Chicago University, but more recently at other meteorological departments in the U. S. A.

N-28935\*

Aeronautical Research Council (Gt. Brit.)  
SUMMARY OF THE THEORETICAL WORK DONE ON  
THE STABILITY OF THIN PLATES, 1939 TO 1946.  
D. M. A. Leggett. 1953. 8p. (ARC R & M 2784.  
Formerly ARC 13,366; Strut 1376)

Attention is drawn to the more important problems of the stability of thin plates which were requiring solutions at the beginning of the war, and progress made towards their solution during the subsequent 7 years is indicated. Three types of problems are discussed: the critical buckling load of a flat rectangular plate when the edges are not all simply supported, the post-buckling behavior of a long flat plate under shear, and the initial and post-buckling behavior of a curved plate under various combinations of shear, compression, and normal pressure.

N-28968\*

Royal Aircraft Establishment (Gt. Brit.)  
TESTS ON THE RELATIVE EFFICIENCY OF  
CHROMATE PIGMENTS IN ANTI-CORROSIVE  
PRIMERS. H. G. Cole. November 1953. 20p.  
diagr., 7 tabs. (RAE Tech. Note Met. 185)

Seawater spray corrosion tests have been made on two magnesium alloys, aluminum alloy, and mild steel, painted with primers made from 18 chromate pigments incorporated in turn in a litho-oil/coumarone medium. Best all round protection was given by zinc monooxy chromate, calcium chromate, and strontium chromate, and good protection by potassium zinc chromate (zinc yellow) and zinc tetroxy chromate. Four complex cadmium chromes and three lead chromates gave poor results. Of the zinc and alkaline earth pigments, those giving best protection were of intermediate solubility.

N-28969\*

Royal Aircraft Establishment (Gt. Brit.)  
CRACK SENSITIVITY, SHEAR STRENGTH, CREEP  
AND WATER ABSORPTION OF BIAXIALLY  
STRETCHED PERSPEX. A. S. Atkinson and W. W.  
Wright. October 1953. 8p. diagrs., 3 tabs. (RAE  
Tech. Note Chem. 1208)

Preliminary tests on samples of biaxially stretched polymethyl methacrylate have indicated that the process reduces sensitivity to cracks, increases the shear strength and reduces creep to an extent which may have practical advantages. On the other hand there is probably an increase in the maximum water absorption.

## UNPUBLISHED PAPERS

N-12563\*

National Bureau of Standards.  
CORROSION OF ALUMINUM-ZINC-MAGNESIUM-  
COPPER ALLOYS. Fred M. Reinhart.  
December 15, 1951. (i), 19p. diagrs., photos., tab.  
(National Bureau of Standards. Rept. 1334)

Aluminum-zinc-magnesium-copper alloys, clad and unclad, anodized and unanodized, were exposed in marine environments to determine their corrosion behavior, and for comparison, specimens of anodized aluminum-copper-magnesium alloys, clad and unclad, were also exposed. Results from this experiment are presented in this report.

N-15972\*

A NEW METHOD IN THE DYNAMICS OF A VISCOUS  
FLUID. (Novyi Metod v Dinamike Vязkoi Zhidkosti).  
V. G. Nevzglyadov. 7p. (Trans. from Akademiia  
Nauk SSSR, Doklady, v. 77, no. 4, 1951, p.573-576)

The velocity vector of an incompressible fluid is written as the sum of two vectors; one satisfies the equation of potential flow, the other is small compared with the first. The flow equation is then obtained by replacing the velocity vector in the Navier-Stokes equation by the sum of these two vectors and neglecting products of the additional velocity vector and its derivatives. The resulting linear equation for the unknown additional velocity vector reduces to Oseen's when the vector obtained from the solution of the potential flow problem is replaced by the velocity vector very far from the body. The equation for the additional velocity vector is not solved; but it is assumed that, on a streamline near the body, the components of the additional velocity vector and their derivatives are determined by a polynomial approximation to the velocity components that is valid from this streamline to the surface of the body.

N-27945\*

National Bureau of Standards.  
ZINC AND CADMIUM PLATED FASTENERS ON  
ALCLAD 75S-T6 ALUMINUM ALLOY. Fred M.  
Reinhart and David B. Ballard. May 6, 1953. ii,  
23p. photos., 2 tabs. (National Bureau of  
Standards. Rept. 2477)

This initial progress report contains the results  
after 9 months of exposure in tidewater, 12 months  
in marine and urban atmospheres. It is tentatively  
concluded that the galvanic corrosion with cadmium  
plated steel fasteners would be less damaging to  
Alclad 75S-T6 aluminum alloy than would that with  
zinc plated steel fasteners.

N-29104\*

Cornell University, Graduate School of Aeronautical  
Engineering. ON THE RELATION AMONG STRESS,  
STRAIN, VELOCITY FROM TESTS ON COPPER  
WIRES SUBMITTED TO LONGITUDINAL IMPACT.  
C. Riparbelli. July 1953. (Rev.) 82p. diagrs.,  
photos. (Cornell University, Graduate School of  
Aeronautical Engineering)

The relation among stress, strain and time rate of  
strain is found by experiments of tensile impact on  
copper wires. The results agree with the hypothesis  
that the velocity of propagation of a small disturbance  
is the same, whether the material is strained  
entirely within the elastic range or whether the dis-  
turbance is introduced and propagated in the  
presence of plastic flow. Results indicate that the  
rate of plastic flow is proportional to the excess of  
the strain.

N-29362\*

DEGREE OF APPROXIMATION OBTAINED BY  
ENERGY METHODS IN CALCULATING EIGEN-  
VALUES. (Sull'Approssimazione dei procedimenti  
energetici per il calcolo di autovalori). Ottorino  
Sesini. February 1954. 15p. diagr. (Trans. from  
Onore di Modesto Panetti, 1950, p. 94-99)

A critical examination is made of the energy methods  
for the approximate calculation of the eigenvalues in  
engineering problems. The methods used by Bryan-  
Timoshenko in his calculations of critical loads and  
those used by Lord Rayleigh or Stodola in calculating  
the natural frequency of vibrating elastic systems or  
the speed of rotating shafts are considered.

## MISCELLANEOUS

N-27708\*

AERODYNAMICS - THEORY, EXPERIMENT,  
APPLICATION. Hugh L. Dryden. 9p. diagrs.,  
photos. (Reprint from Aeronautical Engineering  
Review, v. 12, no. 12, December 1953).

Typical examples from various time periods in the  
growth of aerodynamics in the first half-century of  
flight are given. For clarity, theory, experiment,  
and application are treated as separate lines of  
effort. Today the term aerodynamics is applied to  
this triplet of activities, which, starting as separate  
and almost distinct threads, are now thoroughly in-  
terwoven into the fabric of modern aerodynamics.  
The great strength of aerodynamics and aeronautical  
engineering lies in the close integration and team-  
work of the three groups within the last 20 or 25  
years.

N-3074C

INDEX OF NACA TECHNICAL PUBLICATIONS,  
JUNE, 1951 - MAY, 1953. 1953. viii, 230p.  
(NACA)

There is a classified listing of subject categories; a  
chronological listing of NACA publications under each  
subject category; an alphabetical index to the subject  
categories; and an author index.

NACA Rept. 1127

Errata No. 1 on "ONE-DIMENSIONAL ANALYSIS OF  
CHOKED-FLOW TURBINES." Robert E. English  
and Richard H. Cavicchi. 1953.

NACA RM 54A04

Errata No. 1 on "EFFECTS OF MOLECULAR  
WEIGHT ON CRAZING AND TENSILE PROPERTIES  
OF POLYMETHYL METHACRYLATE." I. Wolock,  
M. A. Sherman and B. M. Axilrod. February 17,  
1954.

## DECLASSIFIED NACA REPORTS

NACA RM L51F04

HYDRODYNAMIC DIRECTIONAL BEHAVIOR OF A  
SWEEP PLANING-TAIL HULL. Donald D.  
Arabian. January 10, 1952. 15p. diagrs.  
(NACA RM L51F04) (Declassified from  
Confidential, 3/9/54)

A qualitative investigation of the low-speed direc-  
tional behavior of a swept planing-tail hull was made  
in the Langley tank no. 2 in still water and still air  
with the use of a free self-propelled model. The  
configuration was directionally unstable over a range  
of low speed. It was, however, directionally con-  
trollable at all speeds by use of the rudder and ele-  
vator. Several modifications that were investigated  
did not improve the controllability.

THE FOLLOWING REPORT  
HAS BEEN DECLASSIFIED  
FROM CONFIDENTIAL, 3/10/54.

RM L9J20

UNIVERSITY OF FLORIDA



3 1262 08153 092 4